HIGH VOLTAGE SURGE PROTECTION ELEMENT FOR USE WITH CATV COAXIAL CABLE CONNECTORS

BACKGROUND OF THE INVENTION

[01] The present invention relates generally to devices for interconnecting coaxial cable to CATV systems, and more particularly to surge protection devices that protect the integrity of electronic components positioned within interconnect devices from high voltage surges of electricity.

[02] In the CATV industry, cable television signals are traditionally transmitted by coaxial cable. As the cable is extended through a distribution network, several types of electrical devices, such as filters, traps, amplifiers, and the like, are used to enhance the signal and ensure signal integrity throughout the transmission. It is therefore necessary to prepare a coaxial cable for interconnection to these devices in such a manner so as to ensure that the signal is not lost or disrupted.

[03] In a traditional interconnection of the coaxial cable to the electrical device, the coaxial cable is attached in axially aligned relation to a conductive pin extending outwardly from the electrical device. The pin then transmits the signal from the coaxial cable to the electrical device. A conductive lead extending rearwardly from the electrical device carries the electrically treated signal to the distribution cable in the CATV system.

[04] It is also necessary to terminate a coaxial cable distribution line at its end point. To terminate the coaxial cable, its central conductor is interconnected to a termination connector, such as a UMTR. The termination connector includes an input end, a body portion which defines a cavity, electrical components mounted within the cavity (for instance, a capacitor to dissipate the charge, and resistor for impedance matching purposes), and an end cap that terminates the connector. The central conductor of the coaxial cable is electrically attached to a pin extending outwardly from the electrical components. As used herein, "connector" will refer to either a termination type connector or any other standard coaxial cable connectors used in a CATV system.

[05] On occasion, a high voltage surge may be transmitted through the coaxial cable, for instance, due to a lightning strike. If this high voltage surge is permitted to be picked up by the input pin and transmitted to the electrical device within the connector, the device would become inoperable due to the electrical components essentially melting or otherwise deteriorating as a consequence of the surge. A new connector would then need to be installed at the site of the surge.

[06] It is therefore a principal object and advantage of the present invention to provide a cable connector having a device that provides an alternate path for high voltage surges of electricity in order to protect the integrity of any electrical components positioned within the connector.

[07] It is an additional object and advantage of the present invention to provide a surge protection device that may be easily installed on an otherwise conventional cable connector.

[08] It is a further object and advantage of the present invention to provide a surge protection device for a cable connector that is inexpensive to manufacture.

[09] Other objects and advantages of the present invention will in part be obvious, and in part appear hereinafter.

SUMMARY OF THE INVENTION

[010] In accordance with the forgoing objects and advantages, the present invention provides a conventional cable connector, such as a UMTR (Universal Male Terminator type connector), that further comprises an element for protecting the electrical components positioned within the connector from high voltage surges. The surge protection element comprises a ring that is positioned in circumferentially surrounding relation to the input pin that carries the signal being transmitted by the coaxial cable. The ring includes at least one, and preferably three prongs that extend radially inwardly therefrom and terminate in close, but non-contacting relation to the pin.

[011] The ring portion of the surge protection element is positioned in contacting relation to a shoulder formed on the body of the cable connector, and is composed of an electrically conductive material, such as, but not limited to, brass. The coaxial cable, which is electrically interconnected to the head of the pin (it should be understood that there may be other common elements disposed between the coaxial cable and head of the pin, such as a tap), passes through the ring portion, adjacent the prong(s), but in non-contacting relation thereto, thereby forming a gap between the prong(s) and cable. If a high voltage surge of electricity is carried by the coaxial cable, such as might occur if it is struck by lightening, a spark will be formed in the gap between the prongs and the cable due to the conductive composition of the surge protection element. As a consequence, the high voltage surge will be transferred to the surge protection element which, in turn, will conduct the electricity to the body of the connector to which it is positioned in contacting relation. The body of the conductor will then carry the high voltage surge of electricity around the electrical components positioned within it, and ultimately to ground. Thus, the high voltage surge will not pass into the electrical components positioned within the connector.

[012] The level of the surge which will trigger the spark to arc between the surge protection element and the coaxial cable may be selectively controlled by using such devices with varying length prongs extending radially inwardly. The closer a prong is positioned relative to the coaxial cable, the lower the voltage level that will cause the spark. The relationship between the size of the spark gap and the voltage level which will trigger a spark is well known in the art.

BRIEF DESCRIPTION OF THE DRAWINGS

[013] The present invention will be better understood and more fully appreciated by reading the following Detailed Description in conjunction with the accompanying drawings, wherein:

[014] Figure 1 is a partial, longitudinal cross-sectional view of a CATV system, including a coaxial cable connector;

[015] Figure 2 is an exploded perspective view of the present invention;

[016] Figure 3 is a perspective view of an embodiment of a surge protection element;

[017] Figure 3A is a perspective view of an alternate embodiment of a surge protection element;

[018] Figure 3B is a perspective view of a second alternate embodiment of a surge protection element;

[019] Figure 3C is a perspective view of a third alternate embodiment of a surge protection element; and

[020] Figure 3D is a perspective view of a fourth alternate embodiment of a surge protection element.

DETAILED DESCRIPTION

[021] Referring now to the drawings, wherein like reference numerals refer to like parts throughout, there is seen in Figure 1 a coaxial cable connector, designated generally by reference numeral 10, extending along a longitudinal axis X-X and having a coaxial cable 12 interconnected thereto. Although not expressly illustrated in the drawings, it should be understood that coaxial cable 12 comprises a central conductor immediately surrounded by a layer of dielectric material of predetermined thickness, an outer conductor concentric with the central conductor and surrounding the dielectric material, and an outer layer of insulating material surrounding the exterior surface of the outer conductor.

[022] Connector 10 generally comprises a conductive body 14 having an input end 16, an output end 18, and a cavity 20 defined therein. Body 14 includes an externally threaded portion 22 positioned at its input end 16 (it should be understood that connector 10 is illustrated as being a "male" UMTR type termination connector, but the present invention would work equally well with female connectors and other standard type connectors used in a CATV system), a shoulder 24 formed interiorly of threaded portion

22 at the interface of input end 16 and cavity 20, and a rear end 26 formed at output end 18.

[023] An electrical component, designated generally by reference numeral 28, and shown illustrated as being composed of a capacitor 30 and a resistor 32 extending rearwardly therefrom, is positioned within cavity 20. It should be understood that electrical component 28 could be any standard type of electrical component that is incorporated into coaxial cable conductors, such as integrated circuits that form filters, amplifiers, traps, and the like. A pin 34 is soldered or otherwise connected to electrical component 28 and extends forwardly therefrom along longitudinal axis X-X. Pin 34 terminates in a head 36 at which point it is electrically interconnected to the central conductor of coaxial cable 12. It should be understood that pin 34 may be separated from the central conductor of coaxial cable 12 by a tap, or other common component used in a CATV system, but it is important that pin 34 be electrically interconnected to the central conductor of coaxial cable 12. Electrical component 28 further comprises a lead 38 that is soldered or otherwise securely connected to body 14 and extends rearwardly from resistor 32 along longitudinal axis X-X.

[024] Connector 10 further comprises a standard end cap 40 positioned in covering relation to output end 18 to protect the connection of lead 38 to body 14, among other things, and an O-ring 41 positioned at the interface of body 14 and threaded portion 22 which prevents moisture, dust, and other contaminants from entering connector 10.

[025] Under normal operating conditions, coaxial cable 12 carries and transmits 90 Volts AC. There may be occasions, however, where high voltage surges impact upon and are carried by coaxial cable 12, such as, for example, in the event it is struck by lightening. If this high voltage surge was to be transmitted to pin 34 and then carried to electrical component 28, the devices comprising electrical component 28 would in most instances become inoperable as they would not be able to receive such surges without their conductive elements melting or otherwise deteriorating.

[026] To prevent a damaging amount of such high voltage surges from being transmitted to electrical component 28, the present invention further comprises a surge protective element, designated generally by reference numeral 42, which is composed of a conductive material, such as bronze, and is of a predetermined width W. Surge protective element 42 generally comprises a ring-shaped outer body 44 and at least one prong 46 extending radially inwardly therefrom. Although surge protective element 42 is illustrated in the drawings as including four, equally spaced apart prongs 46, it has been found that three prongs 46 work just as well, and they need not be equally spaced apart, and one (or any number) prong would also work. The width W and material composition of surge protective element 42 dictate how much voltage it will withstand, but it has been found to withstand voltages of up to 6,000 Volts at 3,000 Amps for a period of 50 microseconds when composed of brass and of a width W of about 0.020 inches, as is required by IEEE Specification 62.41.

[027] Surge protective element 42 is positioned with its body portion 44 in electrically conductive contact with shoulder 24, and prong(s) 46 extending radially inwardly therefrom. To ensure that body portion 44 remains in electrically conductive contact to shoulder 24, surge protective element may be press fit, or otherwise securely engaged with connector 10. When in this position, prong(s) 46 are positioned in close proximity to, but in non-contacting relation to pin 34, thereby leaving a spark gap 48 therebetween (see Figure 1). As is well known in the art, the dielectric strength of air is 3,000,000 Volts/Meter and thus a voltage of 300 Volts will produce a spark in an air gap of 0.1 mm. Thus, the size of spark gap 48 dictates the voltage level at which surge protective element 42 will trigger the electric current to pass through body 14 (and go to ground) instead of through electrical component 28.

[028] Thus, in the event of a high voltage surge of electricity passing through coaxial cable 12, if the surge is above a predetermined value as determined by the size of spark gap 48, a spark will arc across gap 48, and the majority of current will run through prong(s) 46 and to ground through the conductive connection between body portion 44 and shoulder 24 (i.e., a small amount of current may pass into connector 10, but due to

the differences in resistive properties between surge protective element 42 and electrical component 28, only a non-harmful amount of current will pass into connector 10). Accordingly, surge protective element 42 protects electrical components 28 from high voltage surges of electricity by providing an alternate path for the current that goes around the components and to ground through body 14.

[029] Referring to Figures 3A and 3B, alternate embodiments of surge protection element 42' and 42" are illustrated, respectively. Surge protection element 42' comprises a ring-like body 44' (i.e., a washer) and prongs 46' are integrally formed on and extending radially outwardly from the head 36' of pin 34'. The prongs 46' are defined by star shaped protrusions extending radially outwardly from head 36'. Again, surge protective element 42' would work if it included only a single, or any other number of protrusions 46'.

[030] Alternatively, surge protective element 42' could be comprised of only pin 34' having prongs 46' extending radially outwardly therefrom, provided the length of each prong 46' was sufficient to leave an appropriate spark gap between their ends and the internal surfaces of threaded portion 22' (see Figure 3C).

[031] Surge protective element 42" comprises a ring-like body 44" (i.e., a washer), and prongs 46" integrally formed on and extending radially outwardly from the head 36" of pin 34". Prongs 46" are defined by annularly extending, sinusoidal curve shaped protrusions extending radially outwardly from head 36". Again, surge protective element 42" would work if it included only a single, or any other number of protrusions 46".

[032] Alternatively, surge protective element 42" could be comprised of only pin 34" having prongs 46" extending radially outwardly therefrom, provided the length of each prong 46" was sufficient to leave an appropriate spark gap between their ends and the internal surfaces of threaded portion 22" (see Figure 3D).

[033] It should be understood that the shape and composition of surge protection element 42 could vary from those of the disclosed embodiments without departing from the spirit and scope of the present invention as defined in the appended claims.